IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

APPLIED MYCOLOGY

VOL. I FEBRUARY 1922

LINE (J.). **A Note on the Biology of the Crown-Gall Fungus of Lucerne.**—*Proc. Cambridge Phil. Soc.*, xx, 3, pp. 360–365, 7 figs., 1921.

The author's investigations have led to results substantially in agreement with those of Jones and Drechsler (*Journ. Agric. Res.*, xx, 4, p. 295, 1920). Masses of wart-like tissue are found on the diseased plants at about the level of the soil. They may be six inches in width, but rarely extend deeper than one inch below the surface of the ground.

When cut across, these masses show dark-brown areas, the spore cavities among the white tissue composing the gall giving a marbled appearance. The name 'marbled gall' has been suggested to distinguish this type from the true bacterial crown gall. The disease is said to be fairly common on lucerne in certain districts west of the Rocky Mountains; in England it has so far been reported only from three localities: Kent, Bedfordshire, and the vicinity of Cambridge. It is, however, probably often overlooked, as the galls are not easily observed until the plant is removed from the soil. In hot weather normal shoots developing close to the galls may turn yellow and wilt, and thus it is sometimes possible to detect infected plants.

The mature spores are globular, flattened at one pole, 30 × 45 μ, with a very brittle wall nearly 2 μ thick, of a rich golden-brown colour and lined with a thin hyaline membrane. Only a small percentage of spores could be induced to germinate, the process being effected most easily with spores obtained from galls which had rotted owing to the action of fungi (*Fusarium* sp.) or bacteria. The development of external sporangia as described by C. E. Scott (*Science*, N. S., 1340, pp. 225–226, 1920) was not observed.

Apparently the zoospores can only penetrate the host at points where the tissues are inadequately protected by cuticle or cork. The most common starting-points of natural galls are the adventitious buds arising in succession from the woody rootstock of the

lucerne plant. These buds consist of a small axis and a number of leaf rudiments. The zoospores seem to penetrate between the outer scale leaves and to enter the cells of the young leaves and of the growing point. This penetration stimulates the host to increased local cell-division. An extensive branching vascular system develops with the gall in direct communication with that of the host stem; the galls are thus hypertrophied buds or parts of buds. They are first visible as minute, white, shining projections from the rootstock or a bud.

The fungus spreads radially into the host tissues from each point of infection. Active living hyphae are found only in the peripheral regions, the older portions of the gall being occupied by developing resting spores and degenerate mycelium.

A detailed description follows of the development of the fungus. No trace of the plasmodial stage described by Wilson (*Bot. Gaz.*, lxx, 1, pp. 51–68, 1920) was observed. In England the only host plant is *Medicago sativa*. Attempts to infect *M. falcata* and *M. lupulina* have failed. The most usual time of infection is from September to February.

MIÈGE (M. E.). **Note préliminaire sur les principales maladies cryptogamiques observées au Maroc.** [Preliminary Note on the principal Cryptogamic diseases observed in Morocco.]—*Bull. Soc. de Path. Vég. de France*, viii, 1, pp. 37–40, 1921.

Generally speaking, there is not a very large number of fungous diseases, apart from rusts and smuts, at present on record in Morocco.

UREDINEAE. The rusts attack many plants, especially cereals, which are extensively cultivated. *Puccinia graminis* and *P. glumarum* are of frequent occurrence on all species and varieties of wheat. *Triticum durum* appears somewhat less susceptible than *T. sativum* or *vulgare*, but there is little difference between *Hordeum tetrastichum* and *H. distichum* as regards resistance. *Puccinia maydis* occurs on maize, while the species of *Oxalis*, especially *O. cernua*, are attacked by a rust which certain authorities regard as the aecidial stage of *P. maydis*. *P. malvacearum* is also of frequent occurrence. The Uromyces are often found: *U. pisi-sativi* on peas and vetch, *U. fabae* on beans, *U. appendiculatus* on haricots, *U. anthyllidis* on lupins, &c. Flax is attacked by *Melampsora lini*, and roses by *Phragmidium subcorticium*; but the damage caused by these parasites is not very extensive. Rusts occur also on *Ricinus* and *Euphorbia*.

USTILAGINEAE. Smuts, particularly on the coast, are widely diffused among cereals. In 1920 certain species of soft wheat were infected by *Ustilago tritici* to the extent of 25 per cent. Barley is attacked by *Ustilago nuda* and *U. hordei*, the first form being of more general occurrence. *U. maydis* is more rare, and occurs principally on the female inflorescences, though it is also found in the axils of leaves in the form of large tumours. Sorghum is relatively free. *U. cynodontis* has been observed on *Cynodon dactylon*. *Tilletia* is infrequent, though *T. tritici* (probably) has been observed on hard wheat.

PERONOSPORACEAE. The potato is attacked by *Phytopthora in-*

festans, but the ravages of this disease are much less than in France. It is more liable to a disease characterized by wide, brown, well-marked spots appearing on the terminal leaflets, and doubtless caused by a *Sporidesmium*.

CHYTRIDIACEAE. The only fungus belonging to this group actually observed is *Asterocystis radicis* on flax.

SPHAEROPSIDACEAE. Anthracnose (*Ascochyta pisi*) occurs on a certain number of Leguminosae.

MELANCONIACEAE. Anthracnose of clover (*Gloeosporium caulivorum*) was observed in 1920 on wild clover.

AGARICACEAE. *Armillaria mellea* occurs everywhere in abundantly irrigated or fertilized places.

BACTERIAL DISEASES occur chiefly on shrubs, especially olives and almonds, which develop tumours more or less severely. In 1920 wallflowers were attacked.

Mildew and oidium are found on the vine, but the indigenous varieties are remarkably resistant, and the damage to the young European species is not extensive.

UNDETERMINED DISEASES. Beans, peas, chick-peas, &c., have been attacked in various districts by a disease which is causing serious damage. It is specially apt to invade the collar and the base of the stems, but may descend to the tap-root and affect the aerial system. The latter exhibits wine-coloured or brown spots, and finally cracks and dries up, causing the death of the plant.

Another disease has been recently observed on potatoes, but not yet identified.

WHITEHEAD (T.). **On the Life-history and Morphology of Urocystis Cepulae**—*Trans. Brit. Mycol. Soc.*, vii, pp. 65-71, 1 pl., 1921.

The history of the disease, which has only recently been found in Great Britain, is given, together with a description of its characters and the microscopic details of the parasite. The author confirms Thaxter's observation that the sporidia are borne laterally along the promycelium. Under certain conditions they multiply by budding. Conjugation was not observed. Histological observations on the growth of the fungus in the host plant and of the development of chlamydospores are given. Infection is believed to take place at the region of the collar. A bibliography is appended.

THURSTON, Jr. (H. W.) & ORTON (C. R.). **A Phytophthora Parasitic on Peony.**—*Science*, N.S., liv, pp. 170-171, 1921.

Phytophthora has apparently not hitherto been met with on this host. The disease was manifest as a necrotic condition of the bud, involving the surrounding leaves and stem. The symptoms are similar to those caused by *Botrytis*, but the infected areas are darker. No evidence of external fruiting of the parasite was found, but pure cultures were readily made from diseased tissues. Inoculations were successful both with and without wounding the host. The characteristic symptoms appear in from three to six days. Zoosporangia are produced in abundance, and measure 16·7–22·3 x 20·4–29·7 μ. *P. thalictri* would appear to be its closest

relative so far as hosts are concerned, but the sporangia are somewhat broader. Oospores were not observed.

ARTHUR (J. C.). **Origin of Potato Rust.**—*Science*, N. S., liii, pp. 228–229, 1921.

In an earlier note (*ibid.* li, p. 246, 1920) attention was called to the danger of the introduction of the rusts of potato (*Puccinia pittieriana*) and ground-nut (*Puccinia arachidis*) to the United States. The latter has since been reported in Florida, but all vestige of it was at once destroyed. In 1918 the potato rust was very severe in the Experiment Station at Ambato, Equador, and even worse on tomatoes. This is the first record in S. America, the previous known locality being only the highlands of Costa Rica on the potato alone. It was less severe at Ambato in 1919. The suggestion is made that it must have come from some wild host, native to both Ecuador and Costa Rica, there having been no importation of seed from Costa Rica to Ambato on which it can have come.

Abelardo Pachano (in *Bol. de Agric., Quinta Normal*, i pp. 7–12, 1920) described and figured the above rust as it occurred at Ambato.

BISBY (G. R.). **The Co-operative Potato Spraying Project. Progress Report for 1918, 1919, and 1920.**—*Phytopath.*, xi, 4, pp. 178–193, 1921.

Summary statements of the status of the application of fungicides to potatoes in each state and province of the United States and Canada. Certain workers provided new data. The use of Bordeaux mixture is necessary in the North-Eastern states and in Eastern Canada. Its use pays also in Pennsylvania, and evidently in the north central areas, including Ontario, Michigan, Wisconsin, and Minnesota.

Bordeaux mixture appeared to be of little value in Kansas and Arkansas. In certain regions it pays to spray late potatoes, or certain varieties, or to use combination insecticides and fungicides. Copper dusts as developed by Sanders in Canada appear promising. For many areas of North America the value of fungicides for potatoes is as yet uncertain.

WEIMER (J. L.) & HARTER (L. L.). **Glucose as a Source of Carbon for certain Sweet-Potato Storage-rot Fungi.**—*Journ. Agric. Res.*, xxi, 4, pp. 189–208, 1921.

The following is the author's summary:

Eight fungi—*Fusarium acuminatum*, *Diplodia tubericola*, *Rhizopus tritici*, *Mucor racemosus*, *Sclerotium bataticola*, *Penicillium* sp., *Botrytis cinerea*, and *Sphaeronema fimbriatum*—which cause decay of sweet-potatoes in storage, were grown at a constant temperature of 28° C. on a modification of Czapek's nutrient solution, with different amounts of glucose as a source of carbon. All these fungi, except *S. fimbriatum*, utilized glucose in considerable amounts.

The different fungi varied greatly in the amount of glucose they actually consumed at the same concentration. In general, the greatest consumption was in the weaker solution (10 per cent.), and

decreased progressively with the increase of the concentration. With two exceptions all the organisms grew in solutions containing from 42 to 50 per cent. glucose. *Penicillium* sp. alone grew in a 58 per cent. solution.

A great variation was found among the different fungi in the amount of dry material that was produced at the same concentration. The concentration on which the greatest yield of fungous material was produced by a certain organism was not necessarily the optimum concentration for any of the other fungi.

The different organisms varied greatly in the amount of glucose required to produce 1 gm. of dry weight. Likewise the amount required to produce 1 gm. of dry weight of the same fungus differed with the concentration of the solution.

The 'economic coefficient' [the author, following Pfeffer, uses this term for the numerical relation between the sugar consumed and the dry weight of the substance formed] was found to be much higher in many cases than that given by Kunstmann and Ono; the maximum of 28·88 and the minimum of 1·44 being reached by *Mucor racemosus* on a 30 and 50 per cent. solution respectively. The highest 'economic coefficient' for some fungi was on the weaker solutions. For other organisms, however, the order was reversed.

Some of the organisms—namely, *Fusarium acuminatum, Sclerotium bataticola,* and *Sphaeronema fimbriatum*—had little or no influence on the hydrogen-ion concentration. *Rhizopus tritici, Diplodia tubericola, Mucor racemosus, Penicillium* sp., and *Botrytis cinerea,* on the other hand, increased perceptibly the acidity of the solution.

All of the fungi studied grew in solutions with a maximum osmotic pressure varying from 81·33 to 101·46 atmospheres. *Fusarium acuminatum* and *Mucor racemosus* increased the concentration, whereas the other fungi in general decreased it. In a few cases where a considerable amount of sugar was consumed the concentration was actually increased. In general, the decrease in the osmotic concentration was not in proportion to the sugar consumed, so that it is possible that compounds such as organic acids, alcohol, &c. were formed from the sugar which would themselves influence the osmotic concentration.

Weimer (J. L.) & Harter (L. L.). **Respiration and Carbohydrate Changes produced in Sweet-Potatoes by Rhizopus tritici.**—*Journ. Agric. Res.,* xxi, 9, pp. 627–635, 1921.

Experiments were carried out to determine the relative amount of CO_2 given off from the two halves of the same sweet-potato, one of which was rotted by *Rhizopus tritici,* and also the final differences in starch, cane-sugar, and reducing sugar content in the two halves.

It was found that the decayed half gave off 6·3 to 7·8 times as much CO_2 as the healthy, decay being usually completed in three days.

There was less starch, total sugars, and cane-sugar in the decayed portion at the end of the experiment than in the healthy. Reducing sugars were decreased in two experiments and increased in two.

Other investigations have shown that glucose is readily utilized

by the fungus, and cane-sugar, by itself, sparingly or not at all. Even boiled starch is a better source of carbon than cane-sugar. Raw starch can be hydrolysed to some extent by the fungus. The latter seems capable of maintaining a fairly constant supply of reducing sugars obtained from cane-sugar and starch; but glucose must be present before cane-sugar can be absorbed, as when the latter alone is present the growth of the fungus is slight, and it is probable that it does not produce sufficient acid to invert the cane-sugar.

It is thought probable that the increased acidity caused by the growth of the fungus in the sweet-potato causes the inversion of some of the cane-sugar and permits the use of the resulting reducing sugars by the fungus. It will then depend on the amount of growth and activity of the latter whether an excess or a deficiency of reducing sugar is found at the end. The total quantity of carbohydrates lost was greater than that accounted for in the CO_2 produced, and some was therefore apparently used in the building up of the fungus and in the formation of acids, alcohol, &c.

WEIMER (J. L.) & HARTER (L. L.). **Wound Cork Formation in the Sweet-Potato.**—*Journ. Agric. Res.*, xxi, 9, pp. 637–648, 1921.

Sweet-potatoes develop a cork layer over wounded areas under moist conditions, and a hard surface layer under dry conditions. The healed surface in either of these cases forms a fairly good barrier against infection by micro-organisms.

In potatoes that have been in storage for about two months periderm formation was most rapid at a temperature of 33° C., a cork layer being evident in four days, whereas at 31° C. it was first visible in eight days, and at 19·5° C. in eleven days. The relative humidity in these experiments was 95 to 96. Exposure to dry air checks cork formation, but the hard dry surface covering which develops under these conditions was sufficient to prevent artificial infection by *Rhizopus tritici*. The latter is the usual method of healing under storage-house conditions, as the air is kept dry.

PALM (B.). **Slijmziekte in een Rubberplant.** [Slime Disease in a Rubber Plant].—*Teysmannia*, xxxii, 1, pp. 31–33, 1 fig., 1921.

Bacterial diseases have long been known to attack various plants belonging to the Euphorbiaceae, e. g. *Ricinus communis*, *Acalypha*, *Phyllanthus*, and *Codiaeum*, but until lately it had not been observed on any plant actually producing rubber. The Botanical Garden of Buitenzorg (Java) contains a certain number of *Manihot* plants of various species, one of which, *M. glaziovii* (Ceara rubber), produces an abundance of seeds. These are scattered broadcast by birds, and it has recently been discovered that most of the seedlings thus propagated show symptoms of bacterial disease. The affected leaves have a limp appearance during the day, though in the early stages they recover towards evening. Gradually, however, the leaves dry up, beginning at the tips, and this causes a greyish discoloration of the lobes, which finally spreads over the entire surface. It is noteworthy that the stem of the plant remains firm and healthy. Examination showed that the wood vessels were

seriously affected both in the stem and root, even in a comparatively early stage of the disease, bacteria being present in masses.

There appears to be no doubt that the disease is due to *Bacillus solanacearum* E. F. Smith. Cultures of the bacteria from the diseased *Manihot* plants were obtained on sterile potato, the colonies assuming the grey to jet-black colour characteristic of *B. solanacearum*. Tomatoes artificially inoculated with the bacteria from the *Manihot* plants exhibited the typical symptoms of bacterial disease. Considering the close relationship between *Manihot* and *Hevea*, the latter is likely to be attacked by the same disease.

SIMMONDS (H. W.). **A Bacterial Disease of Para Rubber.**—*Agric. Circular* (Dept. of Agric., Fiji), ii, 3, p. 45, 1921.

In a plantation of *Hevea* rubber in the Navua district two trees not far from one another were found in a very diseased condition.

The renewed bark was rough and discoloured, shot-hole borers had attacked this diseased area, and latex was flowing freely from their borings, about half a pound having collected at the foot of one tree. In the other, a big mass of latex, forming between the cortex and the cambium, had forced them apart. The bark in both cases showed a reddish-brown stain, which in one tree had also affected the cambium, whilst a slightly sour smell seemed to be present.

No mycelium was found, but the Government bacteriologist, Dr. Carment, whose report is attached, found bacteria present which were cultured. The organism was a short rod, motile, and with no evidence of spore-formation.

The disease, which has been present in Fiji for many years, does not appear to be highly infective, but is probably carried from one tree to another by the tapping tools of the coolies. If observed early, and tapping be suspended, and the bark scraped and painted with a strong disinfectant, there should be a fair prospect of saving the tree.

HOERNER (G. R.). **Germination of Aeciospores, Urediniospores, and Teliospores of Puccinia Coronata.**—*Botan. Gaz.*, lxxii, 3, pp. 172–177, 1921.

The author summarizes as follows the results of a series of experiments connected with the spore germination of Crown Rust of oats:

Aeciospores from herbarium specimens of *Rhamnus* were not viable after a period of 167 days from date of collection. Urediniospores from herbarium specimens of *Avena sativa* proved to be viable as long as 87 days after date of collection. Unprotected urediniospores lost their viability within 22 days, with a minimum temperature during this period of 27° F., and a maximum of 42° F. When afforded protection with a temperature range similar to the unprotected, these spores remained viable as long as 44 days. Exposed to light, viability of urediniospores was lost within 23 days, during which period the maximum temperature was 86° F., and the minimum 29° F. Kept in the dark, urediniospores at similar temperatures to those exposed to light remained viable as long as 79 days. Urediniospores germinated at a temperature as low as 7° C., with an optimum of 18° C., and a maximum of 32° C. Telio-

spores developed on oat seedlings in the greenhouse and not afforded a period of overwintering did not germinate. Previous to overwintering, and as late in the spring as May 2, teliospores developed in the field were incapable of germination.

BAUDYS (E.). **Die Sporen der Getreidebrandpilze sind nicht giftig.** [The spores of Grain Smuts are not poisonous.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 24–27, 1921.

The writer conducted a number of experiments both on animals and on himself with a view to ascertaining whether the spores of *Tilletia tritici* had any injurious effects.

Poultry fed on smutted grain throve and gained in weight, while mice and rabbits also flourished on the same diet.

No ill effects were experienced by the writer, who therefore concludes that the reports of harm caused by the consumption of infected bread are much exaggerated. The fatal effects consequent on the consumption by animals of grass attacked by *Ustilago longissima* are due, not to the spores themselves, but to the glucosides contained in the grass.

LEE (H. A.) & MEDALLA (M. G.). **Leaf Stripe Disease of Sugar-Cane in the Philippines.**—*Science*, N.S., liv, pp. 274–275, 1921.

Early in 1920 the writers' attention was drawn to the presence in the Philippines of diseased varieties of sugar-cane imported from Formosa. Periodical inspections were made, and in April, after ratooning, numerous cases of etiolation were observed. The light-coloured plants were very conspicuous and could be seen from a considerable distance.

On the lower surface of affected leaves a species of *Sclerospora*, which was not present in the surrounding fields of native cane, was abundant. According to Dr. W. H. Weston (Philippine Downy Mildew of Maize, *Journ. Agric. Res.*, xiv, 3, p. 97), the morphology of *Sclerospora philippinensis* Weston is almost identical with that of *S. sacchari* Miyake. He observed no case, however, of native varieties of sugar-cane becoming infected with the maize mildew, even when growing in close proximity to the diseased maize plants. He was, moreover, unable to cross-inoculate *S. philippinensis* from maize to sugar-cane. Thus the evidence clearly points to the importation of sugar-cane downy mildew, *S. sacchari* T. Miyake, from Formosa.

Measures have been taken to plough up the affected field, burn the stubble, and fallow the land. Steps to trace seed-cane which originated in the affected field are also in progress, and the eradication of the disease may be possible. The present note is intended to emphasize the necessity of a rigid enforcement of the plant quarantine regulations.

BOVELL (J. R.). **Report on the Dept. of Agric., Barbados, 1918–19. Fungus Diseases.** Pp. 26–27, 1921.

The sugar-cane was the principal crop to suffer from fungous diseases, of which the following occurred: *Marasmius sacchari* (Root Fungus), probably due to the adhesion of the fungus to cut-

tings used for planting purposes, or to excessive ratooning. *Himantia stellifera* (Stellate Crystal Root Fungus)—this was much in evidence in a field of second ratoons in the red soil district. The treatment recommended was the application of lime and the planting of a leguminous crop as a green dressing. *Colletotrichum falcatum* (Red Rot) occurred as usual on Bourbon canes at Dodds. *Thielaviopsis paradoxa* (Pine-Apple Fungus)—a large percentage of the sugar-cane cuttings which failed to germinate were attacked by this fungus. Only healthy cuttings treated with Bordeaux mixture should be used for planting. *Cercospora vaginae* (Fungus of the leaf-sheath)—this was greatly in evidence, and the disease was aggravated by the use of infected cuttings.

Sugar-Cane Industry of British Guiana.—*Agric. News* (Barbados), xx, p. 279, 1921.

In a summary of a Report on the Agricultural Conditions of the Sugar Industry in British Guiana, Mr. J. Crabtree, Superintendent of the British Guiana Sugar Planters' Experiment Stations, is quoted as stating that conditions with respect to fungous diseases are at present satisfactory, the only one of any seriousness being root disease in a few localities. An inquiry into the causes underlying root disease is urgently required.

VINCENS (F.). **Parasitisme du Schizophyllum commune Fries sur la Canne à Sucre.** [Parasitism of *Schizophyllum commune* Fries on the Sugar-cane.]—*Bull. Agric. de l'Inst. Scient. de Saigon*, iii, 3, pp. 65–68, 2 figs., 1921.

The writer draws attention to several authenticated cases in which the fungus in question, usually regarded as almost exclusively saprophytic, has developed parasitic tendencies on various trees, e.g. the orange, mulberry, Indian chestnut, rubber, &c. Instances are described of its parasitism on sugar-cane in Indo-China, successful inoculations having been obtained on healthy cuttings of an indigenous variety. The setts were infected either by means of fragments of ripe fructifications of the fungus, or by a suspension of spores in cane-juice. At the end of five months the shoots of the infected cuttings did not exceed 50 cm. in height, and were scarcely more vigorous than those actually taken from the base of diseased plants. The mycelium of the fungus, hyaline and very slender, was found in the tissues of the cuttings, which were still succulent, though reddened.

The appearance of the canes on which the fructifications of *Schizophyllum* occurred suggested the 'Sereh' disease. The diseased portions were dry and marked internally with red streaks.

EDGERTON (C. W.) & MORELAND (C. C.). **Fungi and Cane Germination.**—*Sugar*, xxiii, 1, pp. 16–17, 1 fig. 1921.

The most important fungi attacking cane in Louisiana are:—*Colletotrichum falcatum, Melanconium sacchari, Gnomonia iliau, Marasmius plicatus, Thielaviopsis paradoxa, Fusarium* sp., and *Scopularia* sp. A large number of other forms have also been noticed, including *Sclerotium Rolfsii, Pythium artotrogus*, and species of the following genera: *Agaricus, Rhinotrichum, Alter-*

naria, Penicillium, Aspergillus, Meliola, Rhizopus, Cladosporium, Mucor, Saccharomyces, Acremonium, Catenularia, and *Nectria.*

Colletrotrichum falcatum is the cause of the red rot disease of sugar-cane, and is one of the chief organisms responsible for seed deterioration. It usually enters by way of borer holes. The rind tissue is not attacked unless it is very young and tender, the disease usually being confined to the interior of the stalk. In the red tissues of the stalk are elongated white areas at right angles to the main axis of the stalk. The presence of these spots is conclusive evidence of the disease, but detection is not always easy on account of the absence of external symptoms. Almost the only sign of *C. falcatum* on the rind is the blackened rootlet buds in the nodal region. There are small thin places in the rind of each node where the young roots emerge, and a number of experiments in Louisiana go to prove that the penetration of these thin places by the fungus is responsible for much of the infection. This disease is very serious, the germination percentage of the eyes of stalks inoculated by puncture with this fungus at planting time being reduced about 50 per cent.

Melanconium sacchari, the cause of the so-called rind disease, occurs abundantly on deteriorating cane, but does not seem to reduce the percentage of germination.

Marasmius plicatus causes a disease of the growing cane. It grows in and between the lower leaf-sheaths of the stalk, and the abundant mycelium cements these together so that they remain on the stalk all through the growing season. Stalks affected with the root-rot caused by this fungus are easily recognizable by the presence of the clinging leaf-sheaths and white mycelium. The fungus forms its fruiting-bodies in the fields from July to September.

Gnomonia iliau causes the Iliau or stem rot disease of cane, and is known only in Hawaii and Louisiana. It principally attacks growing canes, and in some respects is similar to the root-rot caused by *Marasmius plicatus.* The lower leaf-sheaths are bound together and also to the stalk itself. Unlike *M. plicatus,* this fungus grows into the stalks from the sheaths. As soon as it begins to fruit it can be readily distinguished on the outside by the numerous black perithecia, with long, hard and sharp-pointed beaks. There is no evidence that these last two fungi reduce the germination percentage.

Thielaviopsis paradoxa is the cause of the so-called pine-apple disease of the sugar-cane. It enters wounds in the rind tissue or at the cut ends and rapidly grows through the whole stalk. The affected region turns darker in colour and frequently there is a central black pipe running lengthwise in the stalk. The intensity of this dark colour can be increased if the stalk is cut open and laid in a moist place for twelve to twenty-four hours. The dark spores of the fungus develop abundantly in such conditions. *T. paradoxa* has not hitherto caused appreciable seed deterioration in Louisiana.

Fungi of the genus *Fusarium* are very common, the two distinct types which occur on cane being known as the purple and white respectively. The former is a very large-spored form, producing deep purple fruiting pustules on the cane and on culture media.

The white *Fusarium* is present in almost every stalk of discoloured seed cane, but it can only be detected by means of cultures. This latter species somewhat reduces germination.

A species of *Scopularia* frequently occurs on the outside of stalks of seed cane, forming patches of greyish mycelium. If the stalks are in a damp place, the conidiophores of the fungus, carrying little heads of spores, develop abundantly. This fungus may also occur on the inside of the stalk in split places, borer holes, &c. It is of little economic importance.

On the whole, sugar-cane does not germinate as well in Louisiana as in the tropics, the average germination being about 20 per cent. The buds or eyes on cane-tops do not germinate as well as those on the bottom halves, presumably on account of the more rapid deterioration of the soft tissues of the cane-tops. The optimum temperature for the growth of several fungi studied in the course of the experiments is approximately 27° C. Seed cane has been treated at planting time with formaldehyde and corrosive sublimate, with encouraging results. In one case a 50 per cent. increase in tonnage was obtained from a plot treated with corrosive sublimate.

MASON (F. A.). **Micro-Organisms in the Leather Industries. I. A Systematic Arrangement of the Fungi mentioned in the Literature of Leather Technology.**—*Bull. of the Bureau of Bio-Technology* (Murphy & Son, Ltd., Sheen Lane, London), 3, pp. 67–78, 1921.

The uncertainty which exists with regard to the names of the species that occur on leather and leather-making materials, and the lack of definite knowledge of the relationships of the fungi to the substances on which they are found have induced the author to attempt the compilation of a systematic list of the species hitherto recorded.

The ZYGOMYCETES include: *Mucor racemosus, M. mucedo, M. piriformis, Circinella simplex, Rhizopus stolonifer, Pilaira dimidiata, Pilobolus crystallinus.* Amongst ASCOMYCETES are: *Saccharomyces ellipsoideus, S. pastorianus, S. acidi lactici, Hansenia apiculata*; whilst FUNGI IMPERFECTI furnish: *Monilia fructigena, Aspergillus glaucus, A. niger, Penicillium* (no recognizable species), *Botrytis cinerea, Verticillium glaucum, Cephalothecium roseum, Cladosporium herbarum, Macrosporium cladosporioides, Alternaria tenuis, Fusarium roseum, F. putrefaciens.* MYCODERMAE, represented by *M. tannica*, have been placed at the end though usually considered along with the yeasts, as their true relationships are uncertain.

It is pointed out that some of the names recorded in the literature, e.g. *Penicillium glaucum*, cannot be recognized, as recent investigations have resulted in the recognition of the fact that this and others of the older 'species' of moulds are an aggregation of several distinct species. A striking instance of dissimilarity in behaviour towards leather by moulds of similar habit of growth, colour, and size is furnished by the unicellular *Mycodermae*, some species of which are quite inert, whereas others, microscopically indistinguishable from them, produce unsightly stains by affecting

the gelatinous fibres composing the *corium*. Hence the necessity for extreme care in the checking of the purity of cultures of organisms during the stages of an investigation.

A rose-coloured and an orange-yellow *Torula*, as well as a *Mycoderma* mentioned by Andreasch, cannot now be recognized, and are therefore not included. Several species of fungi not previously recorded on leather, skins, or tanning materials have been isolated by the author in the course of his work on the microbiology of these substances, while others that are mentioned in the literature have not been encountered.

MASON (F. A.). **Micro-Organisms in the Leather Industries. II. Species of the Genus Penicillium and their Identification.** —*Bull. of the Bureau of Bio-Technology* (Murphy & Son, Ltd., Sheen Lane, London), 4, pp. 87–90, 1 fig., 1921.

In the tabular arrangement of the fungi of leather technology published in Bull. No. 3 (see last abstract), no species of the blue and green moulds belonging to the genus *Penicillium* were included. In this and a later paper several organisms will be discussed which were probably referred previously to *Penicillium glaucum*. Thanks to the work of Thom and Westling, these can now be differentiated into separate species. They are amongst the commonest species found in the tannery.

As a result of the author's examination of leather and raw materials used in its manufacture, the following species can now be recorded: *Penicillium decumbens* Thom, *P. expansum* (Link) Thom, *P. viridicatum* Westling, and *P. lanosum* Westling, together with minute white species so far unidentified, which will be discussed later.

An English translation is appended of Westling's Key to the Green Species of *Penicillium* (Ueber die grünen Spezies der Gattung *Penicillium*, *Arkiv för Botanik, Stockholm*, 1911), which the author has found of the greatest possible value in the routine work of the laboratory. The key is based primarily on the separation of species into the two groups *Eupenicillium* and *Aspergilloides*; the latter group embraces species originally placed by Wehmer in the genus *Citromyces*, but which both Thom and Westling regard as belonging to *Penicillium*.

THILLARD (R.). **La Culture du Tabac de Sumatra au Cameroun.** [Cultivation of Sumatra Tobacco in the Cameroons.]—*L'Agronomie Coloniale*, vi, 40–42, pp. 185–194, 22 figs., 1921.

Tobacco plantations in the Cameroons are subject to several diseases of parasitic and non-parasitic origin, a prominent place among which is occupied by that due to *Phytophthora nicotiana*. This fungus attacks chiefly the collar, covered with earth at the moment of transplantation of the young plants, or roots, and penetrates into the tissues of the plants through any wound, either in the stem or in the roots, caused by unskilled manipulation when transplanting the seedlings. From the wound the parasite destroys the rind, and penetrates into the inner tissues of the stem, attacking the pith, which becomes semi-liquid in wet weather or else, in drier conditions, is broken up into characteristic compartments. The

leaf, or rather its chief vein, early shows signs of the infection; the leaf folds up, withers, and is slowly discoloured. The lower leaves are the first to be altered, the infection spreading gradually on to the upper parts of the plant. The roots of the diseased plant seem weak, and are of a dark-brown colour; when crushed with the fingers they resolve themselves into a blackish pulpy mass. When attacked in wet weather, the leaves present concentric dark-green patches, passing into dark brown. In dry weather such patches on the leaves spread very slowly, and the disease of the stem seems also to be stopped in its progress.

As a means of prevention seedlings should be carefully examined and selected, and only the quite healthy ones, without any stains on the leaves or wounds in the stem and roots, should be planted. When a plant is attacked in the plantation, it must be removed immediately, and in the hole thus formed in the ground some unslaked lime is put, after which the spot is watered with a 20 per cent. solution of ammonia. Surrounding plants must be sprayed for two days with Bordeaux mixture. A new method consists in mixing the earth on the spot from which the plant was removed with 50 gm. of pure permanganate of potassium, and abundantly watering the spot for two days in the morning and evening, when a new plant can be set in. In spite of all these precautions, neighbouring plants can be attacked, and then all the leaves showing spots of *Phytophthora* must be removed and burnt. In order to prevent a recurrence of the disease, all remnants of tobacco plants in the fields must be gathered carefully and incinerated, and this operation is to be the more recommended as it yields ashes of a high fertilizing quality. At Nyombé there was no sign of *Phytophthora* in 1916 and 1917; this was explained by the fact that during the two foregoing years no tobacco had been grown there, and because the new plantations were started in dry weather. In the spring plantations in 1917 and 1918, however, the disease recurred. In the Cameroons, chiefly at Esosung, *Phytophthora* is said to have been present for more than twenty years, the climate being very favourable to its propagation owing to its humidity.

The following diseases are also described as occurring in the Cameroons:

(*a*) Parasitic Rust [parasite not mentioned].
(*b*) Non-parasitic Rust.
(*c*) White spots on the leaves.
(*d*) Mosaic (very frequent).
(*e*) Leaf-curl. This very grave disease first appeared in Nyombé plains, in the Cameroons, in April 1917. In the autumn plantations of 1916 a few curled top leaves had been already noticed, but they were ascribed to attacks of some insect or caterpillar on the terminal bud. Leaves immediately below the point attacked presented small swellings, but there seemed to be no contagion from plant to plant. In April 1917, the weather being abnormally hot, the disease greatly extended in a few days, and this led to the opinion that very dry weather is favourable to the spread of the affection, though it was observed in 1917 that a too great moisture and heavy continuous rainfall also bring about the curling of the leaves. In 1918, however, the weather conditions were very fine, and the

disease recurred again, entailing the same considerable loss in the crop (about 60 per cent.) as in 1917, showing that climatic conditions, although they have an undoubted bearing on the appearance and spread of the disease, cannot alone be responsible for it. Experiments over three years and microscopical investigation gave no clue to the presence of any infective or toxic agents, either in the soil or in the plants, and inoculation of healthy plants with sap taken from diseased ones gave negative results; neither had the use of mineral fertilizers, such as sulphate of potash, superphosphates, &c., any appreciable effect on reducing the spread and gravity of the affection.

The symptoms of the disease are irregular swellings on the leaves, there being an excrescence of tissue between secondary veins on the whole surface of the leaf, the latter curling in a characteristic manner; the diseased plant is atrophied, and does not attain its usual size; a few flower-buds can be produced, but they seldom bloom.

It was observed that the disease appeared on plants grown from seeds gathered in the fields at Nyombé-Penja (altitude about 300 ft. above sea-level) even when the mother-plants were in excellent condition, whereas seeds gathered at Nkongomba at an altitude of about 2,550 ft. gave normal plants, even after several generations. Seeds coming directly from Sumatra also gave excellent results. It is noteworthy that seeds gathered on degenerate and diseased plants and transported elsewhere may give more or less healthy and well-conditioned plants.

HERRMANN (F.). **Züchtung einer gegen die Blattrollkrankheit widerstandsfahigen Tomatensorte durch Auslese.** [Selection of a variety of Tomato resistant to Leaf-curl.]—*Ber. der Höheren staatl. Lehranst. für Obst- und Gartenbau zu Proskau*, 1918–19, p. 111, 1921.

Not only do special varieties of tomato differ in their degree of susceptibility to leaf-curl, but individual plants of the same variety show divergent qualities in this respect. Thus in 1913 one plant out of twenty-five 'Paragons' showed no signs of leaf-curl by the late autumn, whereas the others had begun to curl at the beginning of July. Self-pollinated seed from the immune plant was sown next to the old variety, with the result that only two out of ten plants showed a slight tendency to curl. Four plants with entirely smooth leaves were selected for further propagation, and their forty descendants planted the next year close to a susceptible variety (Schöne Lothringerin). They proved to be practically immune against leaf-curl, and gave a good yield. Resistance to the disease in question appears therefore to be an inherited characteristic, and attention to this fact may greatly improve the individual varieties.

HEINSEN (E.). **Das Auftreten und die Verbreitung des Tomatenkrebses bei Hamburg.** [The Occurrence and Spread of Tomato Canker near Hamburg.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 16–18, 1921.

Tomato plants examined by the writer in September 1919 were severely attacked by a fungus, from 50 to 70 per cent. of

the plants being diseased in some cases. The soil in which the tomatoes were grown was everywhere identical in composition, and equal quantities of lime and animal manure were applied in every instance. In spite of this, however, certain plants were attacked; while others immediately adjoining them remained immune. Several different varieties, e.g. Dutch Grape, Sunrise, Lucullus, Alice Roosevelt, and Danish Export, were equally affected. The owners stated that the disease was most prevalent in damp and cold weather, and also that the spots of the fungus were more numerous on the sunny than on the shady side. The latter statement could not be verified by the author. A marked feature of the disease is the suddenness and violence with which it occurs. All attempts to check the disease by the removal of the affected plants were useless. Thorough ventilation may possibly contribute to the resistance of the plants, but the writer is unable to explain why isolated plants should remain healthy while their immediate neighbours are attacked. In some cases rows of diseased plants alternated with healthy ones.

The small spots on the stalks rapidly spread into large black patches, measuring 6 cm. or more. Sometimes the spots extend round the stalk, at others they are restricted to one side. The attack usually takes place immediately above the level of the soil, but the spots occur also higher up on the stalk. The writer did not observe any traces of the fungus on the lateral branches, the leaves, or the fruit. The spots produce a depression in the cortex, which quickly shrivels. There is a sharp line of demarcation between the sound and the diseased tissues, and the fungus penetrates the interior as rapidly as it spreads over the surface. Microscopic examination has shown the mycelium extending as far as the centre of the stalk.

Treatment has hitherto proved of little use, but an early application of Bordeaux mixture may be recommended.

The disease dealt with in this paper is, according to Klebahn (see next abstract), the canker caused by *Didymella lycopersici* Kleb.

KLEBAHN (H.). **Der Pilz der Tomatenstengelkrankheit und seine Schlauchfruchtform.** [The Fungus of the Tomato-stem Disease and its Perithecial Stage.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1–2, pp. 1–16, 10 figs. in the text, 1921.

In the autumn of 1919 a previously unobserved disease of tomatoes appeared around Hamburg. It attacks chiefly the stems, and within a short time kills the portions of the plant above the point of attack. Younger stems are often attacked at their base and break down.

The disease was first mentioned by G. Massee, who called it Canker, and who states that it can also be observed on cucumber, and that it can pass over from the latter to tomatoes, and from tomatoes to vegetable marrow; according to him the fungus—an *Ascochyta*—is the conidial stage of *Mycosphaerella citrullina* described by Grossenbacher. Other workers in England and Holland accept this determination. Perithecia were not hitherto found on tomatoes.

The author had no difficulty in obtaining pure cultures of the

fungus on artificial media (Salep agar), the resulting mycelium being quite similar to that found in natural cases; the somewhat twisted hyphae consist of short cylindrical cells, three to four times longer than thick, a little thinner in the middle than at the ends, which are rounded and a little swollen. From a central point, which assumes a brown colour, spreads a concentric mycelium, at first quite colourless, and later brown, which progressively invades the whole of the substratum; on the surface appear wavy threads, over which grows an aerial mycelium in flakes of a white colour. Cultivated on sterile fragments of tomato-stems the fungus produced perfect pycnidia in about eight days.

Infected tomato-stems kept during the winter either in a dry room or in the open were covered in the spring with a mass of pycnidia which yielded conidia with quite a similar germinating power to those used in the autumn; on keeping such stems damp for some time, large numbers of perithecia were also found among the pycnidia. Pure cultures were obtained from the ascospores and experiments established that both pycnidia and perithecia belong to the development process of one and the same fungus. By further experiments it was also established that the fungus is not strictly limited to the stem of tomato plants, but that it can also attack and grow on the leaves.

The author's experiments point to the fungus being a true parasite. Inoculations with conidia on the fruit gave decided results only when they were injured, the uninjured epidermis, at least on ripe fruit, being resistant to attack. On the stem, especially in experiments with ascospores, it was clearly established that penetration can occur through the unbroken epidermis, as germ tubes were observed in all stages of penetration into the uninjured cells.

The author objects to Schoevers' classification of the fungus as an *Ascochyta*; the structure of the pycnidia and perithecia is described in detail and compared with the characters of the several genera to which they may be assigned. He concludes that the fungus should be known as *Didymella lycopersici* n. sp., and that other *Mycosphaerellas* with *Ascochyta* stages require re-examination as they may also prove to be *Didymellas*.

Attempts to infect some Cucurbitaceae with this fungus gave negative results, except in the case of *Citrullus vulgaris*, of which two plants showed on a very few leaves a couple of infection foci on which pycnidia with bicellular conidia were found. Hence it is doubtful whether the fungus is the same as Grossenbacher's *Mycosphaerella citrullina*.

WILSON (M.). **A Newly-recorded Disease on Japanese Larch.**—*Trans. Royal Scottish Arbor. Soc.*, xxxv, 1, pp. 73–74, 1921.

A section of the trunk of a Japanese larch (*Larix leptolepis*), 6 ft. long and 2 to 2½ in. in diameter, and showing twelve annual rings at the lower end, was found to be attacked by a fungus apparently identical with *Phomopsis pseudotsugae*.

Two depressed areas appeared on the bark, one near the base and the other towards the upper end. These were darker in colour than the normal bark, elliptical in form, and measured 10 to 11 by 5 in. Considerable quantities of resin were exuded from

the boundaries of these areas. A number of small black fructifications were found on the diseased parts, emerging through small elongated slits in the bark placed at right angles to the longitudinal axis of the stem. The fructifications were of the usual *Phomopsis* type, consisting of pycnidia partially divided up by incomplete septa. The pycnidia had a short, rather wide neck with a terminal opening. The spores were borne on distinct sporophores, and measured 7–8 x 3–4 μ.

The depressions were due to the non-development of the xylem in the infected areas, in which the cambial cells were discoloured and partially disintegrated. The phloem and cortex were still alive, but devoid of starch and permeated by hyphae. The diseased tissue was bounded by a layer of periderm, beyond which the cambium was normal, and developed a zone of secondary xylem. In the healthy tissue the phloem and cortex were normal, the cells of the latter being full of starch.

This is the first recorded instance of *Phomopsis pseudotsugae* on this host. Another new host has also recently been found, viz. *Tsuga albertiana*, on dead leading shoots of which the fungus was seen in Fifeshire in May 1921. On both these new hosts the spores agree exactly with those of the fungus on the Douglas fir, thus differing greatly from *P. abietina*.

SCHMITZ (H.). **Enzyme Action in Polyporus volvatus Peck and Fomes igniarius (L.) Gillet.**—*Journ. Gen. Physiol.*, iii, 6, pp. 795–800, 1921.

The present paper is the third of a series dealing with enzyme production in the wood-destroying fungi, the preceding ones having appeared respectively in (1) *Ann. Missouri Botan. Garden*, vi, pp. 193–200, 1919, and (2) *Journ. Gen. Physiol.*, ii, p. 613, 1919–20. The fungi dealt with were:—*Armillaria mellea* Vahl., *Daedalea confragosa* (Bolt.) Fr., and *Polyporus lucidus* (Leys.) Fr. in (1) and *Echinodontium tinctorium* Ell. et Ev. in (2).

Cultures of *Polyporus volvatus* and *Fomes igniarius* may be obtained from the young sporophores by the tissue method. In both fungi the presence of the following enzymes was demonstrated:—esterase, maltase, lactase, sucrase, raffinase, diastase, inulase, cellulase, hemicellulase, glucosidase, rennet, and catalase. In *Fomes igniarius* urease occurred in addition to the rest.

AVERNA-SACCA (R.). **Molestias da Videira.** [Diseases of the Vine.]—*Bol. de Agric. São Paulo*, Ser. 22, 1 and 2, pp. 6–15, 4 figs., 1921.

Observations on diseases of the vine in the State of São Paulo, associated with *Capnodium salicinum* Mont. and *Pestalozzia uvicola* Speg., are given. The latter fungus was found in a very active state on leaves and clusters of grapes affected by the *Capnodium*. It produces small, irregular, ash-coloured spots on the leaves and fruits, either scattered or close together, covered by small, projecting, black, shiny dots caused by the fructification of the fungus.

Both fungi are described at length, and preventive treatment with Bordeaux mixture is recommended for the latter.

FELICIONI (C.). **Il Roncet nelle viti della Tripolitania.** [Rachitis of the Vine in Tripoli.]—*L'Agricoltura Coloniale*, xv, 10, pp. 507–508, 1 pl., 1921.

Vine-growers in Tripoli are threatened with serious losses from a disease which greatly resembles the typical rachitis attacking *Vitis rupestris*. The disease does not appear to be indigenous, no record of its occurrence being contained in any of the District Commissioners' Reports, which date back to the earliest days of the Italian occupation, or earlier. It has probably been introduced with the grafts imported from Tunis, which are extensively used in the local plantations.

The disease, which is not confined to grafts, is characterized by the abundant production of small, finely indented leaves, sometimes accompanied by the shortening and swelling of the internodes, and by pale spots on the leaves. These symptoms occur, in vineyards of the first year, towards July, i.e. in the second period of vegetation. Scars and necrotic patches also occur on the leaves, especially along the edges, and at the points where the dew collects. The roots show no particular external alteration, and do not appear to be rotted. Some brush-like malformations, however, have been observed, together with a discoloration of the cortical tissue. It has not yet been possible to make a structural examination of the affected organs.

The character of the soil exercises a great influence on the intensity of the disease; thus the vines growing in the alluvial regions of the Wudiâm are more severely attacked than those cultivated in sandy soil, possibly on account of the muddy bed of mixed clay and sand, the compactness of which prevents the drainage of water and aeration of the soil in which the deeper roots are situated.

DOWSON (W. J.). **Some Problems of Economic Biology in East Africa (Kenya Colony).**—*Annals of Appl. Biol.*, viii, 2, pp. 83–100, 1921.

The author gives a sketch of the more important diseases of the chief plants of economic importance dealt with, bringing out where possible the conditions (meteorological and other) which influence the severity of the disease.

Coco-nuts are grown chiefly in the coastal belt with a rainfall of 60 to 70 in., distributed between a short rainy season in November, and a longer one from April to June. The most important disease is the bud-rot, but whether this is bacterial or fungal has not been determined. It attacks palms at the bearing age (seven years) and causes considerable losses. In one case 60 per cent. of young Ceylon palms were killed, and the rest were taken out and replaced by sisal hemp. African varieties seem to be much more resistant than those from Ceylon, which suggests that the disease is probably indigenous. The state of cultivation of the plantation has a considerable influence on the disease. Thus in one case the palms growing amongst the labourers' huts, where the ground was kept clean, showed no sign of bud-rot, while those outside, where weeds flourished around the base of the trees, became diseased.

Sisal hemp (*Agave rigida*, var. *sisalana*) is also grown in the coastal belt. It has few enemies. Ring-spot disease, caused by *Colletotrichum agaves* Cav., has been recorded in a very wet rainy season. The spores of this fungus can be disseminated by air currents. In similar conditions a sun-scorch nearly always takes place, causing large, irregular, reddened patches which render decortication difficult or impossible. In the season when the ring-spot disease occurred a yellow bacterial blotch was found near Nairobi, and by the amount of gum produced on the tissues decortication was rendered impossible. Sunken yellow areas were produced on the upper half of the leaves, varying in size from a small speck to a patch several inches in length. Spread ceased at the end of rains. The organism—a bacillus—was isolated and produced the disease by inoculation. It enters through the stomata. It has not been studied in detail.

Coffee-growing has steadily increased since *C. arabica* was first planted by missionaries a quarter of a century ago. A native species, *C. nandiensis*, is found over 7,000 ft. on steep river banks, under shade. Both species are subject to a number of diseases, meteorological conditions playing a most important part in their severity, especially in regard to the leaf disease *Hemileia vastatrix* B. and Br. Below 4,000 ft. coffee-growing is rendered unprofitable through leaf disease; the high temperature and considerable rainfall are favourable to the growth of the coffee plant, but still more so to *Hemileia*. Near Nairobi, on the other hand, with an altitude of 5,000 to 6,000 ft. and a rainfall of about 30 in., the general balance of conditions is less favourable to the fungus. In the Limuru district the altitude is from 6,000 to 7,000 ft. and the rainfall from 60 to 70 in. The atmosphere is saturated in the mornings and a 'Scotch mist' is the normal experience. In this colder region coffee grows slowly but is hardy, and though *Hemileia* is present it is scarce and does little damage in well-kept estates.

The first attack is in general the most severe, and nearly all the trees may be badly infected. In well-kept plantations only a small percentage of the leaves fall, though the life of the others is shortened. Subsequent attacks cause infection on fewer leaves, and there are not so many rust pustules per leaf. This is not due to any lessening in the virulence of the parasite, as is shown by the severity of the attack on a plantation that has hitherto escaped when others in the vicinity are affected. It is due to an increased resistance of the host after the first attack.

The general health of the tree has much to do with the effects of the disease, the initial preparation of the ground, proper planting of the seedlings, pruning and thinning the crop, being all factors which influence resistance. Spraying has proved successful at altitudes of 5,000 to 7,000 ft. Any dilute fungicide will not only control the disease, but will completely eradicate it if applied at the right time. Spraying is not necessary in the Limuru district, and is useless below 4,000 ft. The most popular fungicide, known locally as 'carbide', is prepared by adding 12 oz. of calcium carbide to 40 gals. of a solution containing 2 lb. copper sulphate in water. Between 4,000 and 5,000 ft. a stronger mixture, containing 4 lb. copper sulphate and 24 oz. calcium carbide to 40 gals. water, has given

encouraging results on well-cultivated estates. At such altitudes, it is essential to spray regularly to keep *Hemileia* in check.

Other diseases of coffee mentioned are the leaf and berry spot due to *Cercospora coffeicola* B. and Cke., which has caused considerable damage on neglected plantations, and is favoured by heavy and prolonged rains. It is easily controlled by spraying with carbide or weak Bordeaux mixture. Another berry spot, due to infection by a species of *Septoria*, which in its effects on the fruit is similar to that produced by *Cercospora coffeicola* and which may be identical with *S. maculosa* (Berk.) Cke. recorded on coffee berries from Venezuela, is more often met with on low-lying heavy soil, and does considerable damage unless checked by spraying when the berries are still green.

Rot of the roots occurs only on badly prepared ground and wherever old stumps and roots—which are always sources of infection by root-destroying fungi—have been left in the soil.

Die-back of the branches is particularly troublesome in districts where the rainfall exceeds 45 in. and the soil is heavy. Among the various contributory causes rendering the trees liable to this disease, which up to the present is not fully understood, are unhealthy conditions of cultivation, water-logged soil, attacks of *Hemileia*, over-bearing, insufficient pruning, and the presence of *Colletotrichum coffeanum* Noack. General conditions are less favourable in Uganda, where die-back is of frequent occurrence. So far, all attempts to elucidate the true cause of a very singular die-back of the stem, which has been reported more than once from nearly every coffee district, have met with failure. In nearly every case the disease was reported shortly after a heavy thunderstorm had passed over the plantations, and was at first ascribed to lightning. Circular patches of trees from twenty to fifty in number were discovered with shrivelled and blackened foliage; the least affected were on the outside, while there was always one tree in the centre more stricken than the rest, intermediate stages occurring between. The shoots bearing the blackened leaves were dead towards the tips; and for some distance down each shoot, including the main stem, the cortex was discoloured and the cambium disorganized. Unless the affected parts were cut off well below the discoloration in the cortex, the trees invariably died slowly back to the roots. It was found by examining old dead specimens that the cambium had been replaced by a brown mycelium, and very often the fructifications of a *Diplodia* were found on the bark, while the pycnidia of a *Phoma* and a *Phomopsis* were always present. Inoculation experiments have disproved the theory put forward that the disease was due in the first place to the *Phoma* or the *Phomopsis*, and the problem, which is of economic importance, calls for a more thorough investigation.

Amongst the forest trees of the Highlands *Juniperus procera* is subject to the attacks of the bracket fungus *Fomes juniperinus* (Schrenk) Sacc. and Syd., which causes great damage by producing a heart-rot. About 70 per cent. of the trees are affected. The fungus is probably a wound parasite.

An important *Sclerotinia* disease affecting young seedlings of *Brachylaena hutchinsi* has been recorded and partially investigated

in the nurseries of the Forestry Department near Nairobi. Young trees were found to wither and die when from 3 to 4 feet high, and the roots showed numerous small black sclerotia, irregular in shape, clinging to the base of the stem just below ground level. Their size varied from a rounded mass 1 mm. in diameter to a flat irregularly-shaped mass 1 cm. across. Apothecia were produced on long (½ in.) stalks after a few months on sclerotia kept under conditions as natural as possible, but they never succeeded in reaching maturity and when nearly ripe withered and died, through being infested by eel-worms, which may thus keep the spread of the fungus in check.

In Citrus trees the most serious disease, if not the most common, is the foot-rot or mal-di-gomma, usually ascribed to *Fusarium limonis* Briozi, but which the author thinks is more likely due to bacteria in the first place. The *Fusarium* is probably secondary, and gains entrance through cracks in the bark due to the activity of the bacteria. Various bacterial leaf-spots, in which the Citrus Canker of the Gulf States and South Africa is not included, are common in the dry season and cause great damage by defoliation, especially in neglected groves or on stiff soil which is apt to become water-logged in the rains. The most common form of these appears as large concentric rings of small blisters, hard in texture and brown in colour.

Wheat grown in East Africa is subject to attacks by the following rusts:—Black stem-rust (*Puccinia graminis* Pers.), yellow rust (*Puccinia glumarum* Eriks. and Henn.), and brown or leaf rust (*Puccinia triticina* Eriks.). While in England *P. glumarum* is the commonest and most destructive, and in Australia *P. triticina* causes most damage, in East Africa the greatest destruction is due to *P. graminis*, *P. glumarum* being, in addition, very common on certain wheats of Egyptian origin. These two rusts usually, and *P. triticina* nearly always, appear late in the season, generally after the wheat has come into flower. Climatic conditions are important factors in the spread of the rust, and by choosing early maturing varieties of wheat it is possible to avoid the disease altogether. This has been demonstrated at Nairobi, where there are two rainy seasons, during both of which early maturing wheats, such as the Australian 'Florence' which matures in four months, were successfully grown. Though not a rust-resistant variety, 'Florence' escapes the rust attack if sown early enough, while 'Bobs', another Australian wheat that takes six to seven months to ripen, always falls a victim to *P. triticina* and *P. graminis*. It has been shown by experiment that excess of nitrogen in the soil renders wheat more susceptible to attacks of rust, and that flax, being an exhaustive crop, is the most useful one to precede it, since it removes the excess of nitrogen. The following rotation of crops has been found to give excellent results: (1) flax, (2) wheat, (3) beans, (4) flax or maize. A rust-resisting hybrid (Cross No. 13) has been successfully evolved by crossing 'Egyptian No. 3' and 'Nut Cut', while Cross No. 11, a selection from the hybrid 'Early Rieti' and 'Red Fife', is highly resistant to *P. graminis*.

The chief fungous enemy of flax is the wilt due to *Fusarium lini* Boll., the conidia of which have probably been borne on im-

ported seed. Experiments designed to find out what effect the action of formalin vapour (liquids being unsuitable for flax seed-disinfection owing to the mucilaginous seed-coat) would have on the germinating power of the seed brought out the unexpected fact that germination was more rapid with a higher concentration of the gas than with a lower. The effect on the *Fusarium* has not yet been tried.

Second Rapport de la Station Agronomique de la Guadeloupe, 1919–1920, pp. 21, 22, 35–42, 1921.

The two most important pests which attack sugar-cane plantations in the island are said to be *Diatraea saccharalis* (Moth-borer) and the fungous root disease *Marasmius sacchari*. Extensive local statistics are given of the degree of susceptibility of each variety of cane cultivated in the island to these troubles, and growers are recommended to exercise the strictest care in the choice of plants and to concentrate on the resistant varieties.

Administration Report of the Department of Agriculture in Mesopotamia for the Year 1920, pp. 5, 6, 29, 30, and 42, 1921.

The most important fungous diseases identified were:

WHEAT. Black rust (*Puccinia graminis*); brown rust (*Puccinia glumarum*); orange rust (*Puccinia triticina*); loose smut (*Ustilago tritici*); stinking smut (*Tilletia tritici*). BARLEY. Rust and smuts (both loose and covered smut) do considerable damage, and late blight (*Helminthosporum teres*) is a very serious disease in this country. SORGHUM. Short and long smut are both very common on local as well as imported varieties. COTTON. Black mould (*Aspergillus* sp.), white mould (*Rhizopus* sp.), and brown mould (*Alternaria* sp.) were observed on the bolls. The sore-shin fungus was found particularly on seedlings sown deep or with bad tilth. RICE. Burnt ear disease, prevalent in 1919, has not been reported in 1920. GROUND NUT. Tikka leaf-spot (*Cercospora personata*). DATES. Leaf-spot and smut. CITRUS. Die-back, said to be caused by a *Phoma*, is the most serious disease; gummosis and canker have also been observed. GRAPE. Leaf-spot (*Cercospora viticola*). PEACH AND NECTARINE. Leaf-curl, due to *Exoascus deformans*, is spreading rapidly in the districts round Baghdad. APPLE. Scab is very common.

LEVINE (M.). **Studies on Plant Cancers. II. The Behaviour of Crown Gall on the Rubber Plant (Ficus elastica).**—*Mycologia*, xiii, pp. 1–11, 2 pl., 1921.

The rubber plant was used in inoculation experiments with *Bact. tumefaciens* in order to determine the effect of the organism on mature evergreen perennials under uniform greenhouse conditions. When inoculations were made in the stem or leaves benign or malignant neoplasms were formed, one kind in which growth was uniform and another type indicating a peripheral growth of isolated nodules. The early stages of development of the stem galls did not interfere with the growth of the plant. Finally the gall becomes hard and dies, and although the entire conducting system of the

stem is not destroyed, the stem above the gall nevertheless dies, as well as a part below.

An organism was isolated from old galls and the stem above, which appeared to be *Bact. tumefaciens* in too depauperate a condition to bring about the production of a new growth in the affected plant.

EISLER (M.) & PORTHEIM (L.). **Über die Biologie des Bacillus carotovorus Jones.** [The Biology of *Bacillus carotovorus* Jones.] —*Centralblatt für Bakt.*, liii, 1–3, pp. 7–33, 1921.

The writers were unable to obtain inoculations on the raw roots of *Daucus carota* with a strain of *Bacillus carotovorus* cultivated for years on agar. The bacteria developed in some cases on slices of cooked carrots, but failed to grow on others on account of their higher acidity. When the acidity was neutralized with soda solution all the slices were attacked. Bacteria taken from successful cultures on cooked carrots flourished and became more virulent when transferred to roots previously heated to 56° C., and were then able to infect some of the raw carrot roots. Subsequent transfers from the latter gave a strain that was constantly infective. This strain also grew in the sap of the cooked carrots in which the non-virulent strain failed to grow. Against these virulent bacteria the natural acidity of the roots is of no avail, and infection can only be counteracted by mechanical processes, such as the formation of periderm and wound-tissues. Any decrease in the capacity to form such protective tissues brought about by external influences helps the entry of the bacteria. So also the non-susceptible raw roots can be rendered susceptible by neutralizing with soda solution. The strains thus obtained on hosts artificially made susceptible are then capable of attacking normally resistant roots.

The soft root-rot of *Daucus carota* was thus obtained by the writers from their pure culture strain only after the bacteria had been cultivated on carrots, the resistance of which was artificially lessened. A successful infection results on the one hand from increasing the virulence of the parasite and on the other from diminishing the resistance of the host.

MANNS (T. F.) & ADAMS (J. F.). **Prevalence and Distribution of Fungi Internal of Seed Corn.**—*Science*, N. S., liv, pp. 385–387, 1921.

The fungi occurring within kernels of *Zea Mays* are determined by means of the following technique:—Fifteen or more kernels are disinfected in a test-tube 150 × 20 mm. for one minute in a solution of 50 per cent. alcohol containing 1 gm. $HgCl_2$ per litre. The kernels are then washed in the same tube with two successive washings with 20 c.c. each of sterile water, and ten kernels are immediately removed with sterile forceps and placed with the germ side down on 20 c.c. of nutrient glucose agar in a culture dish. Five of the remaining kernels are placed each in a sterile culture dish and the point of the kernel (which contains most of the internal infection) is cut off one-sixth to one-fifth inch from the end; each of these points is then taken with a strong sterile scalpel and placed in the mouth of a heavy-walled tube containing 10 c.c. of sterile

agar at 40° C., and crushed and shaken down into the medium, mixed, and poured into the dish containing the remaining part of the kernel. Germination tests of the corn were also made. The following fungi were obtained from within seeds:—*Cephalosporium sacchari*, in 39·54 per cent. of the 3,285 kernels cultured from Delaware, and also, in percentages varying from 2 to 46, from sixteen of the twenty other states from which tests were made; this is said to be the first report of this fungus in the United States.

Gibberella saubinetii was obtained commonly (fourteen states), the percentage varying from 1·33 to 25·83, and *Fusarium moniliforme* even more frequently than the *Gibberella*. *Diplodia zeae* was obtained from thirteen of the twenty-one states, and although it occurred in only 0·8 to 14 per cent. of the kernels, it was found when present to be the most important of these fungi in inhibiting germination of the seed.

DICKSON (J. G.), JOHANN (HELEN), & WINELAND (GRACE). **Second Progress Report on the Fusarium Blight (Scab) of Wheat.**—Abs. in *Phytopath.*, xi, p. 35, 1921.

From two hundred specimens of wheat scab from sixteen eastern and central states in 1920 *Gibberella saubinetii* was obtained in all but four cases, in which *Fusarium avenaceum* was found. Only 15 per cent. of the specimens produced perithecia in 1920, as contrasted with 51 per cent. in 1919. Infection occurs principally when the wheat is in flower, initial infection usually occurring through extruded anthers. Rapid development of the disease ensues if there are three or four days of warm humid weather.

FRASER (W. P.) & BAILEY (D. L.). **Biologic Forms of Wheat Stem Rust in Western Canada.**—Abs. in *Phytopath.*, xi, p. 202, 1921.

One form of wheat stem rust was found to be more common and widely distributed than the others, of which there were at least three. All were similar to biologic strains found in the United States.

NEWTON (MARGARET). **Biologic Forms of Wheat Rust in Western Canada.**—Abs. in *Phytopath.*, xi, p. 202, 1921.

At least five forms of wheat stem rust occur in Western Canada. These are identical with forms isolated in the United States by Stakman. A rather virulent strain is quite widely distributed.

DOYER (L.). **Fusarium-Befall des Getreides.** [*Fusarium* attack on Cereals.]—*Angew. Botanik*, iii, 3–4, pp. 75–83, 1921.

During 1920 the writer investigated a number of cases of *Fusarium* infection of wheat at Wageningen, Holland, and made the following observations. In the dry state grains infected with *Fusarium* are scarcely distinguishable from healthy ones; occasionally, however, they show a reddish discoloration near the germ, or may even be shrivelled. When kept moist the hyphae soon become visible on the surface. The variety of wheat principally studied was the Japhet summer wheat, which was severely attacked

(30 to 40 per cent. of diseased grains) by *Gibberella saubinetii* (Mont.) Sacc. The grains are covered with a violet and brown mycelium, interspersed with clusters of indigo-coloured perithecia. The conidial stage is a *Fusarium* with 5-septate spores, 50 × 5 μ in diameter, often diffused in the mycelium.

In other, less frequent, cases the attack was due to *Fusarium culmorum* (W. G. Sm.) Sacc. (= *F. rubiginosum* App. et Wr.), which produces masses of brown spores, 35 × 6 μ, and a sparse violet mycelium. Occasionally also deep pink to orange sporodochia and a thin white mycelium occur on the grains. The spores, which are long and narrow, measure 65 × 3 μ. These belong to *F. avenaceum* (Fr.) Sacc. (= *F. subulatum* App. et Wr.). Similar sporodochia may be produced by *F. herbarum* (Cda.) Fr. (= *F. metachroum* App. et Wr.).

There were only a few instances of attack by *F. minimum* Fuck. (= *F. nivale* Fr.).

With a view to ascertaining the effects of seed infection on the resulting crop in *G. saubinetii*, infected samples of Japhet wheat were sown in the spring of 1920, and harvested at the beginning of September. Many of the ears were attacked, masses of pink spores and numerous perithecia occuring on the glumes, and also on the base of the stalk. The internodes showed no external signs of attack, but the nodes were covered with perithecia and *Fusarium* spores. Transverse sections through the stalks showed the hyphae of the fungus situated in the parenchyma cells, which have large lumina and relatively thin walls. The mycelium spreads rapidly from one cell to another, and may be found so high up in the stalk as to make it very possible that the ears are infected in this way. Furthermore, typical *Fusarium* cultures can be obtained from the infected internodes after surface sterilization. All this points to the probability of internal infection, a theory which has hitherto received little attention.

In the case of *F. nivale*, Schaffnit distinguishes between primary and secondary infection of the grain, the former taking place in the immature stage and checking development, and the latter occurring at the fully ripe period. Only in the last case is treatment with various fungicides useful before sowing, since the earlier attacked grains are not capable of germination even after disinfection. The author believes that the same occurs with *G. saubinetii*.

Infection is probably also disseminated by means of the perithecia on the stalk, which remain with the stubble in the soil and can affect the crop the following year, or even later.

The seedlings resulting from sowing infected grain are not always sufficiently damaged to prevent their subsequent development. Symptoms of the attack may be observed on the coleoptile and first leaves, but the subsequent growth may appear sound. Further research will no doubt show that such cases carry internal infection.

Thus the three types of disease which Schaffnit has described in *F. nivale*—seedling disease in which the young seedling is attacked and either checked in its development or destroyed, foot-rot in which the base of the stem is chiefly attacked, and ear or grain infection—occur also with *G. saubinetii* and are connected directly with one another. Starting with grain infection, diseased seed-

lings are obtained which may fail to develop or may give an infected plant on which, at a later stage, the symptoms of the stem-base attack (foot-rot) develop. On this infected plant the ear is attacked by internal spread of the mycelium from below and the newly-formed grain becomes infected from within.

HAMBLIN (C. O.). **Flag Smut and its Control.**—*Agric. Gaz. of New South Wales*, xxxii, 1, p. 23, 1921.

Wheat can be infected by this fungus (*Urocytis tritici*) both through the soil and through the grain to which the spores adhere. The best methods of control appear to be rotation of crops, fallow, early preparation of the seed-bed, conservation of soil moisture, and pickling, while the burning of diseased stubble is also very important.

The pickling process, employed as a preventive of stinking smut, has a cleansing value for flag smut only if the paddocks have not previously been badly infected by it. If a rotation of crops is impossible, the land should be ploughed and worked as soon after the harvest as possible, the moisture thus conserved most likely resulting in the germination of the flag smut prior to the sowing. A late variety would in this case be of advantage. It is of importance to note that spores of the fungus survive the digestive processes and are still capable of germinating, hence the disease may be spread from paddock to paddock by horses and cattle.

POLE EVANS (I. B.), THOMSON (MARY R. H.), PUTTERILL (V. A.), & HOBSON (G.). **Further Investigations into the Cause of Wastage in Export Citrus Fruits from South Africa.**—*Dept. of Agric. S. Africa, Bull.* No. 1, 48 pp., 20 pl., 1921.

This publication contains reports on micro-organisms affecting citrus fruits in S. Africa, by Mary R. H. Thomson and V. A. Putterill, and on the state of the fruit when received in England, by Geo. Hobson, together with an introduction by I. B. Pole Evans.

Brown rot (*Pythiacytis citrophthora*) and cottony mould (*Sclerotinia libertiana*), which cause serious losses in California, are unknown in S. African orchards and packing-sheds, where the wastage is due in the first place to *Penicillium digitatum* (Fr.) Sacc.; *P. italicum* Wehm. and *Colletotrichum gloeosporioides* Penz. are minor causes of loss. These fungi apparently gain entrance to the fruit only through a bruise or injury to the skin caused by handling or by insects, so that, with reasonable care, losses from this cause should be largely avoidable. The wastage appears to be directly proportional to the amount of injury sustained by the fruit.

Tests, spread over a considerable period, were carried out in the orchards, packing-sheds, and railway trucks to determine the number of species of spores contained in the atmosphere. Tables are given enumerating the fungi found on agar plates exposed (*a*) during five seconds, (*b*) during fifteen seconds; the resulting colonies included, besides *P. digitatum* and *P. italicum*, other species of *Penicillium*, *Hormodendron*, *Phoma*, *Alternaria*, *Isaria*, *Mucor*, *Epicoccum*, one *Aspergillus*, one *Helminthosporium*, *Capnodium* (?), and numerous yeasts. Old packing-cases left in packing-sheds,

when moved, released innumerable spores of citrus-rotting fungi, and this was also the case with affected fruit lying about. The general conclusions drawn are, that it is of prime importance to handle the fruit with great care so as to avoid bruising or otherwise injuring the skin; that affected fruit must be destroyed by burning, and that packing-sheds require frequent disinfection and scrupulous cleanliness at all times; that the fruit truck should be clean and well ventilated and the packs so stacked as to allow free circulation of air amongst them; that the boxes should be made of smooth, well-seasoned, clean and strong wood, leaving sufficient space for good ventilation between the boards; and that the fruit should be cured for three days before being packed.

A case of South African oranges, on arrival in London, was found to contain a great number of rotten fruits, and embedded in a mass of these could be seen oranges in a perfectly sound condition, their skins having suffered no injury. Hence the most important point to keep in mind is that rotting organisms can only attack citrus fruits through a skin injury.

CARMENT (DR.). **Coco-nut Bud-rot Disease (Taviuni).**—*Agric. Circ.* (Dept. of Agric., Fiji), ii, 4, pp. 94–95, 1921.

Samples taken from diseased coco-nut buds at Taviuni (Fiji) were culturally examined and found to contain the characteristic bacillus of the *coli* group, side by side with fungi. The latter must be regarded as saprophytic and not disease-producing. The bacillus in question was inoculated on glucose peptone water and found to be negative in regard to indol production and positive to the Voges and Preskauer reactions. It can therefore be definitely stated that the *Bacillus coli* of bud-rot does not belong to the classical type of *coli communis* organisms, of human origin.

ELLIOTT (J. A.). **A New Phoma Disease of Cotton.**—Abs. in *Phytopath.*, xi, p. 48, 1921.

A hitherto unreported disease of cotton in Arkansas appeared in 1920 and made very rapid progress during a period of cool, wet weather. All plants were killed in small patches in severe cases; in others the stand was greatly reduced. A change in weather conditions abruptly checked the progress of the disease and many plants recovered. Scars of the lesions caused by the disease were found throughout the summer. The parasite, a species of *Phoma*, was isolated and successful inoculations obtained both in wounded and unwounded tissues. All parts of the plant above ground can be attacked, and extension in the tissues is very rapid, but a high degree of humidity is essential for the activity of the fungus.

BROOKS (F. T.) & KIDD (M. N.). **The 'Black Spot' of Chilled and Frozen Meat.**—*Dept. of Sc. and Ind. Res., Food Invest. Board*, Special Rep. No. 6, 6 pp., 1 pl., 1921.

Consignments of beef and mutton brought from the Argentine, New Zealand, and other countries to England are sometimes found to be disfigured by the presence of black spots on the surface. The result of detailed investigations of the occurrence and nature of this condition, which may cause the meat to be condemned at the

port of entry, is described by the authors. Towards the end of the war and afterwards it was fairly common on account of the long periods of storage that were necessary.

'Black Spot' is caused by *Cladosporium herbarum* and affects all kinds of frozen meat. It has been found that the fungus develops at temperatures down to 18° F. (−7·7° C.) to 22° F. (−5·5° C.), and its spores are then of the same character as those produced at ordinary temperatures, namely, oval spores, 8 to 16 μ × 4 to 5 μ, which may be once septate, and roughly spherical spores 3·5 to 5 μ in diameter, budded off in chains from the former. But conidiophores arising under cold-store conditions are sometimes entirely unbranched, thus differing from those produced at normal temperatures. 'Black Spots' were produced artificially in cold storage, the time taken being about six months. This, however, was shortened by keeping the tubes and pieces of meat at ordinary temperature for 24 to 48 hours after inoculation, before placing in cold storage. The lower the temperature, the slower the growth, but, since at temperatures above freezing-point competing bacteria may prevent the development of the fungus, the optimum temperature for 'Black Spot' must be placed at, and just below, freezing-point.

On meat, *C. herbarum* develops particularly upon the subcutaneous connective tissue, whether overlying muscle or fat, the brownish-black fungal threads sometimes penetrating the underlying tissues, especially muscle, to a maximum observed depth of about 4 mm. Material in which the meat is packed also carries the fungus.

Whilst meat affected by 'Black Spot' is unsightly, the presence of *C. herbarum* alone does not render it dangerous or unfit for human consumption, as no toxic substances are produced during growth, whether upon meat or other substrata. Large quantities of the fungus consumed by one of the authors mixed with other food have failed to produce deleterious results. During the latter part of the war much meat spotted in this manner was legitimately saved by trimming away the most conspicuously damaged parts. 'Black Spot' on meat may, however, be accompanied by putrefactive bacteria, and should then be condemned; the presence of the latter can easily be ascertained by the characteristic odour produced. Other fungi which may or may not accompany *C. herbarum* are white moulds (species of *Sporotrichum* and *Oospora*), bluish-green moulds (*Penicillium* spp.), pink yeasts, together with the profuse growths known in the trade as 'whiskers' (*Mucor* spp. and *Thamnidium* spp.). White moulds are known to develop at temperatures below freezing-point, but this is not established as yet in the case of the others.

VAN DER BIJL (P. A.). **A Paw-paw Leaf-spot caused by Phyllosticta sp.**—*South African Journ. of Science*, xvii, 3–4, pp. 288–290, 1921.

A leaf-spot disease, which does not seem to have been previously reported as occurring on paw-paw (*Carica papaya*) in South Africa, though it is not uncommon in Natal, is caused by a *Phyllosticta*.

The attacked leaves show white spots of an average breadth from 2 to 5 mm., circular, or angular, or more or less elongated in

one direction, and frequently coalescing. These are often bounded by a yellow or brownish margin, which gradually merges into the normal green of the leaf. The tissues of the spots ultimately become brittle, and fall out, giving a shot-hole appearance. Black dots, consisting of pycnidia, may be observed about six days after infection in the spots on the upper surface of the leaves.

The mycelium appears to be primarily intercellular, and the author thinks it excretes an enzyme which kills the cells of the host, as these are much shrivelled up and collapsed in the affected area; in section the latter appear thinner than the rest of the leaf. The pycnidia are at first sub-epidermal, but later become erumpent; they are globose, from 80 to 106 μ in diameter, and with thin walls. The spores are hyaline, straight to slightly curved, rounded at both ends, and measure 4·4 to 5·8 $\mu \times 1{\cdot}5$ to 1·8 μ.

The fungus grows well in culture, though pycnidia do not appear to be readily formed. They were obtained on beerwort agar plates, and were up to 133 μ in diameter.

Inoculations with pure cultures gave positive results both on unwounded leaves and wounded fruits. This suggests that the fungus may possibly cause a fruit-rot in nature.

Of the three fungi, *Phoma microsporella* Karst. and Har., *Phyllosticta papayae* Sacc., and *Ph. caricae-papayae* Allesch., recorded as causing leaf-spots of the paw-paw, the author thinks that his species should be referred to the last-named.

CAYLEY (DOROTHY M.). **Some Observations on the Life-history of Nectria galligena Bres.**—*Ann. of Botany*, XXXV, 137, pp. 79–92, 2 pl., 1921.

The author describes a series of observations, both on bark and in pure cultures, on the life-cycle of the fungus isolated from canker on apple trees in England, which agrees in morphological and biological characteristics, except for the somewhat larger dimensions of the ascopores, with *Nectria galligena* Bres., not with *N. ditissima* Tul.

The only media found on which the fungus completed all the stages of its life-history, including the development of perithecia, were those containing starch or some derivative of starch, with one per cent. glycerine. Potato slopes in glycerine gave the best results.

The cultural characters of the fungus are fully described, together with the cytological details of the development of the perithecium and ascogenous hyphae. The further development of the asci was not followed. No definitely recognizable pycnidia were obtained in culture, though pycnidia occur on the bark in close proximity to the perithecia.

In addition to the micro- and macro-conidia described by former observers, the author observed a two-celled multinucleate conidium with eight or more nuclei in each cell when mature. Unstained, they cannot be distinguished from two-celled macrospores.

Inoculations with macrospores from pure cultures produced typical sunken cankered areas on one-year-old apple twigs in spring.

STONE (R. E.). **Leaf Scorch or Mollisiose of Strawberry.**—Abs. in *Phytopath.*, xi, p. 44, 1921.

A disease of strawberry leaves prevalent in Ontario, and characterized by purple spots and later by a dried scorched appearance, is caused by the imperfect fungus *Marssonia potentillae* (Desm.) Fisch. This fungus was found to have as its ascigerous stage *Mollisia earliana* (E. and E.) Sacc., the connexion between the two forms being established by culture and typical infections obtained with ascospores.

ZELLER (S. M.). **Heart-rot of Prune and Peach in Oregon.**—Abs. in *Phytopath.*, xi, p. 105, 1921.

In Western Oregon the chief cause of heart-rot of these stone fruits is *Trametes carnea* (Nees) Cke., which causes more wood decay in the trees than all other fungi. Large pruning wounds are the most common place of infection. Two other fungi, *Lenzites saepiaria* Fr. and *Fomes pinicola* (Sw.) Cke., which are also usually found on coniferous hosts, very frequently cause heart-rot of peach and prune.

MARCHAL (El. et Em.). **Contribution à l'étude des champignons fructicoles de Belgique.** [Contribution to the study of fruit fungi in Belgium.]—*Bull. de la Soc. Royale de Bot. de Belg.*, liv (N. S. iv), 31 pp., 2 pl., 1921.

Owing to war conditions the authors' investigations of the fungi occurring on fruits, extending over six years, were restricted to the region round Gembloux in the province of Namur, but even so several thousand specimens were collected, of which 815 formed the subject of study. In the majority of cases pure cultures were obtained. The following list includes twenty-four new species or varieties, of which the Latin diagnosis is given, and in some cases figures:

PHYCOMYCETES: *Mucor mucedo, M. racemosus, M. fragilis, Chaetocladium Jonesi, Phytophthora infestans, P. omnivora, Pythium de Baryanum, P. intermedium.* ASCOMYCETES: *Eurotium Aspergillus glaucus, Sclerotinia Fuckeliana, S. cinerea, S. fructigena, Nectria galligena, Venturia cerasi, V. inaequalis, V. pirina, Pleospora lycopersici* n. sp., *Diaporthe perniciosa*, n. sp.; also various Saccharomycetes. FUNGI IMPERFECTI: *Phoma destructiva, Dothiorella vinosa* n. sp., *D. mali* var. *globuligera* n. var., *Fuckelia conspicua* n. sp., *Fusicoccum malorum* var. *macrosporum* n. var., *F. rimosum* n. sp., *Cytosporella fructorum* n. sp., *Cytospora personata, Septoria piricola, Sphaeropsis pseudodiplodia, Hendersonia vagans* var. *fructicola* n. var., *Gloeosporium album, Coryneum longistipitatum, Oospora umbrina* n. sp., *O. perpusilla, Geotrichum candidum, Monilia cinerea, M. fructigena, Hyalopus pruinosus* n. sp., *Botryosporium diffusum, Eidamia acremonoides, Aspergillus fuliginosus, A. glaucus, Penicillium brevicaule, P. glaucum, P. flavum* n. sp., *P. olivaceum, P. olivaceum* var. *discoideum* n. var., *P. roseum, Gliocladium cinereum* n. sp., *Acrostalagmus cinnabarinus, Cephalothecium roseum, Ramularia candida, R. magnusiana, R. macrospora, R. cerasorum* n. sp., *Echinobotryum atrum, Torula lamelligera* n. sp., *T. pulveracea, Stachybotrys alternans, Fusicladium*

cerasi, *F. dendriticum*, *F. pirinum*, *Cladosporium herbarum*, *Macrosporium sarcinaeforme*, *M. solani*, *Alternaria tenuis* var. *mali* n. var., *Tilachlidium nigrescens* n. sp., *T. malorum* n. sp., *Isaria felina* var. *pirina* n. var., *Graphium fruticolum* n. sp., *Stysanus stemonites*, *Tubercularia piricola* n. sp., *Dendrodochium pulchrum* n. sp., *D. versicolor* n. sp., *Fusarium solani*, *F. coeruleum*, *F. subulatum*, *F. oxysporum*, *F. Willkommii*.

The conidial form of *Pleospora lycopersici* n. sp. is stated to be *Macrosporium sarcinaeforme* Cav., thus confirming the existence of a relationship between certain members of the genus *Pleospora* and conidial forms of the *Macrosporium* type.

Cultures of *Diaporthe perniciosa* n. sp. on different media have established with certainty the connexion between the ascigerous stage of the fungus and *Fusicoccum malorum* Oud. Cultures of the latter on branches of pear and apple trees produced, after several weeks, the perithecia of the *Diaporthe*, and from the ascopores of this pycnidial stromata and, later, fresh perithecia were obtained. These cultures showed considerable variations in the character of the fungus, as regards the dimensions of the perithecial necks and the grouping of the perithecia. The pycnidial stage is still more variable in culture, so much so, that it seems possible that several other previously described forms may be merely variations of *Fusicoccum malorum* Oud. *Aposphaeria pomi* Sacc. and Schulze, and *Myxosporium mali* Bres., are amongst these. *D. perniciosa* is—at least in the Namur district—one of the most frequent causes of rot in late varieties of apple and pear, especially in dry surroundings, causing a brown-black, slowly spreading spot usually at the stalk-end. Pycnidial fructifications cover the spots very late in the rotting process, while perithecia are observed very exceptionally in the spring on completely mummified fruits. Plums and peaches are also attacked before ripening, becoming covered with stromata, cracking, drying up, and falling. *D. perniciosa* hibernates on the branches, especially on pear and apple, less frequently on plum and cherry, producing a canker in the outer layers of the bark; it rarely attacks the cambium and is not so serious as *Nectria galligena*. The bark infections give rise to numerous pycnidial stromata in the autumn which remain hidden in the external layers, thus simulating certain species of *Myxosporium*. Perithecia are formed later and rather capriciously. Inoculations with *Fusicoccum* spores on wounded young apple twigs in August showed the cortex invaded and pycnidial stromata forming in November.

Dothiorella vinosa n. sp. seems to be a ubiquitous species, having been found as a parasite on the leaves of plum trees and on the bark of pear and apple trees and red currant bushes. It is a frequent cause of rotting of certain varieties of apples and pears, producing a large, dark brown spot with a progressive dissolution of the tissues. The mycelium long remains sterile, pycnidia only appearing on completely rotted fruits.

Fuckelia conspicua n. sp. has been found on fallen pears of the varieties Bésy de Chaumontel and Joséphine de Malines, and once on apple. The affected fruits are entirely covered with dark olive-coloured pycnidia, growing close together, below which the fleshy pulp is completely invaded by the mycelium. Spermatia, either

mixed with the normal spores, or in special spermagonia, occur both in culture and on the fruit. They have resisted all efforts at germination.

Fusicoccum rimosum n. sp. differs from *F. malorum* Oud. in the character of the disk and in the position of the opening; it has been found on tomatoes gathered before complete maturity.

Notes are given on the other species mentioned in the list above, especially regarding their parasitism, frequency, and the hosts on which they occur. Besides the new forms, twenty-one are new for the Belgian flora.

HARTER (L. L.) & WEIMER (J. L.). **Studies in the Physiology of Parasitism with Special Reference to the Secretion of Pectinase by Rhizopus tritici.**—*Journ. Agric. Res.*, xxi, 9, pp. 609–624, 1921.

The following is the authors' summary:

Rhizopus tritici produces a powerful intracellular and extracellular pectinase when grown in sweet-potato decoction. The enzyme is able to effect the complete maceration of raw sweet-potato disks so that coherence of the cells is entirely lost. The optimum temperature for maceration is between 45° and 55° C. At 60° deactivation of the enzyme is nearly instantaneous; below 45° the activity of the enzyme decreases simultaneously with the decrease in temperature.

The maximum enzyme content of the hyphae and the solution is attained in about 24- and 48-hour-old cultures, respectively. The volume of the enzyme solution of a given strength does not influence the rate of maceration; the concentration of the enzyme in the solution does. Exposure of the hyphae for two hours to direct sunlight does not affect the macerating power. Centrifuging to remove the sand and fungous débris slightly deactivates the enzyme. Filtering the solution in which the powdered hyphae and sand are suspended through filter-paper weakens the enzyme; filtering the solution after the removal of the fungous felt does not reduce its strength. Extraction of the powdered hyphae for eighteen hours in water does not increase the rate of maceration when compared with hyphae not extracted. Toluol may safely be employed as an antiseptic without impairing the action of the enzyme. The quantity of sand used for grinding the hyphae does not influence the action of the enzyme. The treatment of the hyphae with acetone for twelve minutes and ether for three minutes has no influence on the macerating action of the hyphae. Washing the hyphae in running water for fifteen minutes has no influence on the action of the enzyme. The results of these investigations indicate that work of this type, involving a study of the relationship existing between a host and its parasite, may throw some light on the important question of parasitism.

Rhizopus tritici belongs to a large group of organisms, incapable of themselves of penetrating the unbroken cells of the epidermis mechanically or of dissolving them with enzymes. However, after it has once reached the tissues beneath the epidermis, it progresses with great rapidity. It, like certain other organisms, is characterized by its ability 'to act in advance' of its growth.